

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, GERMANIUM, POWER TYPES 2N1042 THROUGH 2N1045

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for PNP, germanium, power, transistors.

* 1.2 Physical dimensions. See figure 1.

* 1.3 Maximum ratings.

$P_T \frac{1}{T_C = 25^\circ C}$	V_{CBO}				V_{EBO}	I_C	T_{stg} and T_{op}
	2N1042	2N1043	2N1044	2N1045			
\underline{W}	$\underline{V_{dc}}$	$\underline{V_{dc}}$	$\underline{V_{dc}}$	$\underline{V_{dc}}$	$\underline{V_{dc}}$	$\underline{A_{dc}}$	$\underline{^\circ C}$
20	-40	-60	-80	-100	-20	-3	-55 to +100

$\frac{1}{2}$ Derate linearly 267 mW/ $^\circ C$ for $T_C > 25^\circ C$.

* 1.4 Primary electrical characteristics at $T_C = 25^\circ C \pm 3^\circ C$.

Limits	h_{FE} $V_{CE} = -1 V_{dc}$ $I_C = -3 A_{dc}$	h_{FE} $V_{CE} = -0.5 V_{dc}$ $I_C = -50 mA_{dc}$	$V_{CE(sat)}$ $I_C = -3 A_{dc}$ $I_B = -300 mA_{dc}$	$ h_{fe} $ $V_{CE} = -1.5 V_{dc}$ $I_C = -0.5 A_{dc}$ $f = 125 kHz$	V_{BE} $V_{CE} = -1 V_{dc}$ $I_C = -3 A_{dc}$
			$\underline{V_{dc}}$		$\underline{V_{dc}}$
Min	20	50	---	2	---
Max	60	250	-0.75	10	-1.5

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

- * MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500.

3.3 Design, construction, and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figure 1.

- * 3.3.1 Lead material and finish. Lead material shall be Kovar or alloy 52. Lead finish shall be gold-plated. (Leads may be tin-plated if specified in the contract or order, and this requirement shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking (see 6.2).

- * 3.3.1.1 Lead material. If lead material need be specified, it shall be specified in the contract or order (see 6.2).

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

- * 3.5 Marking. Devices shall be marked in accordance with MIL-S-19500.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

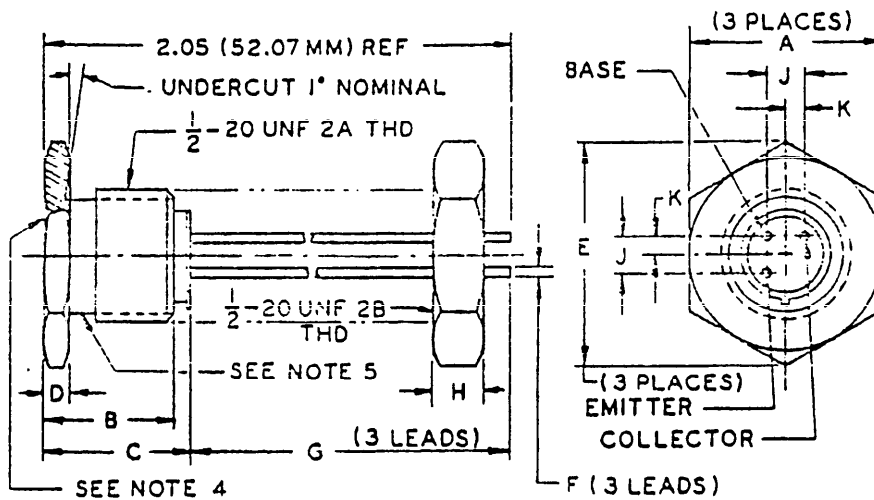
- * 4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

- * 4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

- * 4.3.3 Group C inspection. Group C inspection shall consist of the tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every six months during production.



DIMENSIONS					NOTES
LTR	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.740	.760	18.80	19.30	6
B	.485	.515	12.32	13.08	
C	---	.550	---	13.97	
D	.083	.103	2.11	2.62	
E	---	.875	---	22.23	6
F	.022	.028	.56	.71	7
G	1.500	1.750	38.10	44.45	7
H	.177	.197	4.50	5.00	
J	.1314	.1514	3.34	3.85	
K	.0707 Nom		1.80 Nom		

NOTES:

1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. The orientation of the leads in relation to the hex flats is not controlled.
3. The collector shall be electrically connected to the case.
4. Temperature measurement point 0.160 nominal from center of heat sink.
5. Thread relief is 0.090 max. by 0.430 dia. nominal.
6. Three places.
7. Three leads.

FIGURE 1. Physical dimensions of transistor types 2N1042 through 2N1045.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (see 4.4.3)			Min	Max	
<u>Subgroup 1</u>			10				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Breakdown voltage, collector to base	3001	Bias condition D; $I_C = -750 \mu\text{Adc}$		BV_{CBO}	-40 -60 -80 -100	---	Vdc Vdc Vdc Vdc
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = -100 \text{ mAdc}$		BV_{CEO}	-30 -40 -50 -60	---	Vdc Vdc Vdc Vdc
Emitter to base cutoff current	3061	Bias condition D; $V_{EB} = -20 \text{ Vdc}$		I_{EBO}	---	-650	μAdc
Collector to emitter cutoff current	3041	Bias condition A; $V_{BE} = +0.2 \text{ Vdc}$		I_{CEX}	---	-650 -650 -650 -650	μAdc μAdc μAdc μAdc
Collector to base cutoff current	3036	Bias condition D		I_{CBO}	---	-125 -125 -125 -125	μAdc μAdc μAdc μAdc
Collector to emitter cutoff current	3041	Bias condition D		I_{CEO}	---	-25 -20 -20 -20	mAdc mAdc mAdc mAdc
<u>Subgroup 3</u>			5				
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}; I_C = -3 \text{ Adc}$ pulsed (see 4.4.1)		h_{FE}	20	60	---
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}; I_C = -1 \text{ Adc}$ pulsed (see 4.4.1)		h_{FE}	30	150	---
Forward-current transfer ratio	3076	$V_{CE} = -0.5 \text{ Vdc}; I_C = -50 \text{ mAdc}$		h_{FE}	50	250	---

TABLE L Group A inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (see 4.4.3)			Min	Max	
<u>Subgroup 3 - continued</u>							
Collector to emitter voltage (saturated)	3071	$I_C = -3 \text{ Adc}$; $I_B = -300 \text{ mAdc}$ pulsed (see 4.4.1)		$V_{CE(sat)}$	---	-0.75	Vdc
Collector to emitter voltage (saturated)	3071	$I_C = -1 \text{ Adc}$; $I_B = -100 \text{ mAdc}$ pulsed (see 4.4.1)		$V_{CE(sat)}$	---	-0.25	Vdc
Base emitter voltage (nonsaturated)	3066	Test condition B; $V_{CE} = -1 \text{ Vdc}$; $I_C = -3 \text{ Adc}$ pulsed (see 4.4.1)		V_{BE}	---	-1.5	Vdc
Base emitter voltage (nonsaturated)	3066	Test condition B; $V_{CE} = -1 \text{ Vdc}$; $I_C = -50 \text{ mAdc}$		V_{BE}	---	-0.5	Vdc
<u>Subgroup 4</u>							
Small-signal short-circuit forward-current transfer ratio	3206	$V_{CE} = -1.5 \text{ Vdc}$; $I_C = -0.5 \text{ Adc}$	5	h_{fe}	25	100	---
Magnitude of small-signal short-circuit forward- current transfer ratio	3306	$V_{CE} = -1.5 \text{ Vdc}$; $I_C = -0.5 \text{ Adc}$; $f = 125 \text{ kHz}$		$ h_{fe} $	2	10	---
<u>Subgroup 5</u>							
High-temperature operation:		$T_C = +85^\circ\text{C}$	10				
Collector to base cutoff current	3036	Bias condition D					
2N1042		$V_{CB} = -20 \text{ Vdc}$		I_{CBO}	---	-5	mAdc
2N1043		$V_{CB} = -30 \text{ Vdc}$			---	-5	mAdc
2N1044		$V_{CB} = -40 \text{ Vdc}$			---	-5	mAdc
2N1045		$V_{CB} = -50 \text{ Vdc}$			---	-5	mAdc
Collector to emitter cutoff current	3041	Bias condition A; $V_{BE} = +0.2 \text{ Vdc}$					
2N1042		$V_{CE} = -20 \text{ Vdc}$		I_{CEX}	---	-5	mAdc
2N1043		$V_{CE} = -30 \text{ Vdc}$			---	-5	mAdc
2N1044		$V_{CE} = -40 \text{ Vdc}$			---	-5	mAdc
2N1045		$V_{CE} = -50 \text{ Vdc}$			---	-5	mAdc
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}$; $I_C = -3 \text{ Adc}$ pulsed (see 4.4.1)		h_{FE}	20	75	---
Low-temperature operation:		$T_C = -55^\circ\text{C}$					
Forward-current transfer ratio	3078	$V_{CE} = -1 \text{ Vdc}$; $I_C = -3 \text{ Adc}$ pulsed (see 4.4.1)		h_{FE}	15	---	---

TABLE II. Group B Inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (see 4.4.3)			Min	Max	
<u>Subgroup 1</u>			20				
Physical dimensions	2066	(See figure 1)		---	---	---	---
<u>Subgroup 2</u>			15				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test condition A, except in step 3, $T_A = +100^\circ + 5, -0^\circ\text{C}$		---	---	---	---
Thermal shock (glass strain)	1058	Test condition A		---	---	---	---
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	5×10^{-7}	atm cc/s
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D					
2N1042		$V_{CB} = -20 \text{ Vdc}$		I_{CBO}	---	-125	μAdc
2N1043		$V_{CB} = -30 \text{ Vdc}$			---	-125	μAdc
2N1044		$V_{CB} = -40 \text{ Vdc}$			---	-125	μAdc
2N1045		$V_{CB} = -50 \text{ Vdc}$			---	-125	μAdc
Forward-current transfer ratio	3076	$V_{CE} = -1 \text{ Vdc}; I_C = -3 \text{ Adc}$ pulsed (see 4.4.1)		h_{FE}	20	60	---
<u>Subgroup 3</u>			10				
Shock	2018	Nonoperating; 1,500 G; 0.5 ms; 5 blows in each orientation: X_1, Y_1, Y_2 , and Z_1		---	---	---	---
Vibration, variable frequency	2056			---	---	---	---
Constant acceleration	2008	10,000 G in each orientation: X_1, Y_1, Y_2 and Z_1					
End points: (Same as subgroup 2)							
<u>Subgroup 4</u>			10				
Terminal strength (lead fatigue)	2036	Test condition E		---	---	---	---
Terminal strength (stud torque)	2036	Test condition D2; torque = 20 in-lbs; time = 15 s		---	---	---	---

TABLE II. Group B Inspection. - Continued

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (see 4.4.3)			Min	Max	
<u>Subgroup 4 - Continued</u>							
End points:							
Hermetic seal	1071	Test condition G or H for fine leaks; test condition A, C, D or F for gross leaks		---	---	5×10^{-7}	atm cc/s
<u>Subgroup 5</u>							
Salt atmosphere (corrosion)	1041		20	---	---	---	---
<u>Subgroup 6</u>							
High-temperature life (nonoperating)	1032	T _{stg} = +100°C; time = 340 hours (see 4.3.4)	7	---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias condition D					
2N1042		V _{CB} = -20 Vdc		I _{CBO}	---	-250	μAdc
2N1043		V _{CB} = -30 Vdc			---	-250	μAdc
2N1044		V _{CB} = -40 Vdc			---	-250	μAdc
2N1045		V _{CB} = -50 Vdc			---	-250	μAdc
Collector to emitter cutoff current	3041	Bias condition A; V _{BE} = +0.2 Vdc					
2N1042		V _{CE} = -40 Vdc		I _{CEX}	---	-1.3	mAdc
2N1043		V _{CE} = -60 Vdc			---	-1.3	mAdc
2N1044		V _{CE} = -80 Vdc			---	-1.3	mAdc
2N1045		V _{CE} = -100 Vdc			---	-1.3	mAdc
Forward-current transfer ratio	3076	V _{CE} = -1 Vdc; I _C = -3 Adc pulsed (see 4.4.1)		h _{FE}	16	72	---
<u>Subgroup 7</u>							
Steady-state operation life	1027	+25°C ≤ T _C ≤ +55°C V _{CE} = -20 Vdc $P_T = 12W + \left(\frac{55^\circ C - T_C}{3.75^\circ C/W} \right)$ time = 340 hours (see 4.3.4)	7	---	---	---	---
End points:							
(Same as subgroup 6)							

TABLE III. Group C inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details (see 4.4.3)			Min	Max	
<u>Subgroup 1</u>			10				
Thermal resistance (junction to case)	3138	$T_1 = T_C = 30 \pm 5^\circ\text{C}$ $T_2 = T_J = 95 \pm 5^\circ\text{C}$ $I_C \text{ (measurement)} = -50 \text{ mAdc}$		θ_{J-C}	---	3.75	$^\circ\text{C/W}$
<u>Subgroup 2</u>			10				
Resistance to solvents	---	MIL-STD-202, Method 215 (see 4.4.2)		---	---	---	---
<u>Subgroup 3</u>			$\lambda = 10$				
High-temperature life (nonoperating)	1031	$T_{\text{stg}} = +100^\circ\text{C}$ (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							.
<u>Subgroup 4</u>			$\lambda = 10$				
Steady-state operation life	1026	$+25^\circ\text{C} \leq T_C \leq +55^\circ\text{C}$ $V_{CE} = -20 \text{ Vdc}$ $P_T = 12\text{W} + \left(\frac{55^\circ\text{C} - T_C}{3.75^\circ\text{C/W}} \right)$ (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							

- * 4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hour life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria, see 4.3.3.
- * 4.3.5 Lot representative (group B and C inspections). At the option of the manufacturer, the highest voltage type represented in the lot may be used for group B and C inspections as representative of a lot containing the several types.
- 4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III.
- * 4.4.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.
- * 4.4.2 Resistance to solvents. Transistors shall be subjected to tests in accordance with method 215 of MIL-STD-202. The following details shall apply:
- All areas of the transistor body where marking has been applied shall be brushed.
 - After subjection to the tests there shall be no evidence of mechanical damage to the device and markings shall have remained legible.

- * 4.4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be conducted at a case temperature (T_C) of $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$.

5. PREPARATION FOR DELIVERY

- * 5.1 See MIL-S-19500, section 5.

6. NOTES

- 6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

- * 6.2 Ordering data.

- (a) Lead finish if other than gold-plated (see 3.3.1).
- (b) Lead material (see 3.3.1.1).

6.3 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modification, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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